Complete the following directives or answer the questions given below for each problem. Provide your answers in a WORD document. Embed tables, graphs, or figures where needed in this document.

For problems 1 and 2, consider the Keating electrical use beginning in 2010 through the end of 2020.

1. You are asked to develop a model that can be used to obtain short-term forecasts (up to six months) based on the kWh/day.

a. Develop a regression model that uses time, beginning in January 2010. Use indicator variables for the months. See the EXCEL file.

b. Write down the equation and interpret each coefficient in the model.

c. How well does the model fit the data? Discuss R2 , the adjusted R2 , …

d. Check the assumptions of normality, linearity (for time only), constant variance and independence of residuals.

e. Prepare a six-month forecast with prediction intervals.

2. Fit a straight line to the centered moving average using a twelve-month window for the kWh/day using time alone.

a. Write down the equation.

b. Compare the coefficient for time obtained in this model with the coefficient for time in the regression model that also uses months as predictors.

c. Use the residuals from this model to estimate a monthly effect.

For problem 3, consider the quarterly unemployment data from the federal bureau of labor statistics (FBLS) from 2010 – 2020. See the EXCEL file.

3. Use the Holt-Winter trend and seasonally adjusted model to model unemployment rates from 2010 through 2020.

a. Use 𝛼𝛼 = 0.20, 𝛾𝛾 = 0.10 and 𝛿𝛿 = 0.10. Use the first 10 observations to initiate the level and growth rates. Use the first four years to initiate the seasonal effect.

b. Graph the original and the Holt-Winters model as functions of time. Discuss difference in the observed values and the forecasted values. Where was the greatest disparity between observed and forecasted values?

c. What initial values of level and growth would have produced the smallest mean-squared error when 𝛼𝛼 = 0.20, 𝛾𝛾 = 0.10 and 𝛿𝛿 = 0.10. By how much did the mean-squared error of the forecast drop?

d. Forecast the unemployment rate with prediction intervals for the first quarter of 2021. How does that compare with the observed value unemployment of 6.2%? Did the first quarter unemployment rate 2021 fall within the prediction interval?

e. Which values 𝛼𝛼, 𝛾𝛾 and 𝛿𝛿 minimize mean-squared error for the Holt-Winters method? By how much was the mean-squared error of the forecast decreased?

f. What do these values say about the time series?

g. Graph the forecasted model and original data as functions of time. Did the optimization make an appreciable difference?